



**PLEASE CHECK FOR CHANGE INFORMATION  
AT THE REAR OF THIS MANUAL.**

# **7A29 AMPLIFIER**

**WITH OPTIONS**

## **INSTRUCTION MANUAL**

**Tektronix, Inc.  
P.O. Box 500  
Beaverton, Oregon 97077**


**070-2320-00  
Product Group 42**

**Serial Number \_\_\_\_\_**

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### INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag,  
or stamped on the chassis. The first number or letter  
designates the country of manufacture. The last five digits  
of the serial number are assigned sequentially and are  
unique to each instrument. Those manufactured in the  
United States have six unique digits. The country of  
manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

# SERVICE SAFETY INFORMATION

## FOR QUALIFIED SERVICE PERSONNEL ONLY

The following are safety precautions which appear in the service information sections of this manual. This Service Safety Information is in addition to the Operators Safety Information given previously.

### WARNING

#### DO NOT SERVICE ALONE

*Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.*

#### DISCONNECT INSTRUMENT POWER

*To avoid electrical-shock hazard, disconnect the instrument from the power source before removing protective panels, soldering, or replacing components.*

### CAUTION

#### AVOID EXCESSIVE MOISTURE

*Circuit boards and components must be dry before applying power to prevent damage from electrical arcing. Pins 2 and 3 of U246 and U266 are especially sensitive to moisture. Excessive moisture in this area of the circuit board will cause the trace to wander irregularly and possibly leave the screen area.*

#### EXERCISE CARE WHEN SOLDERING

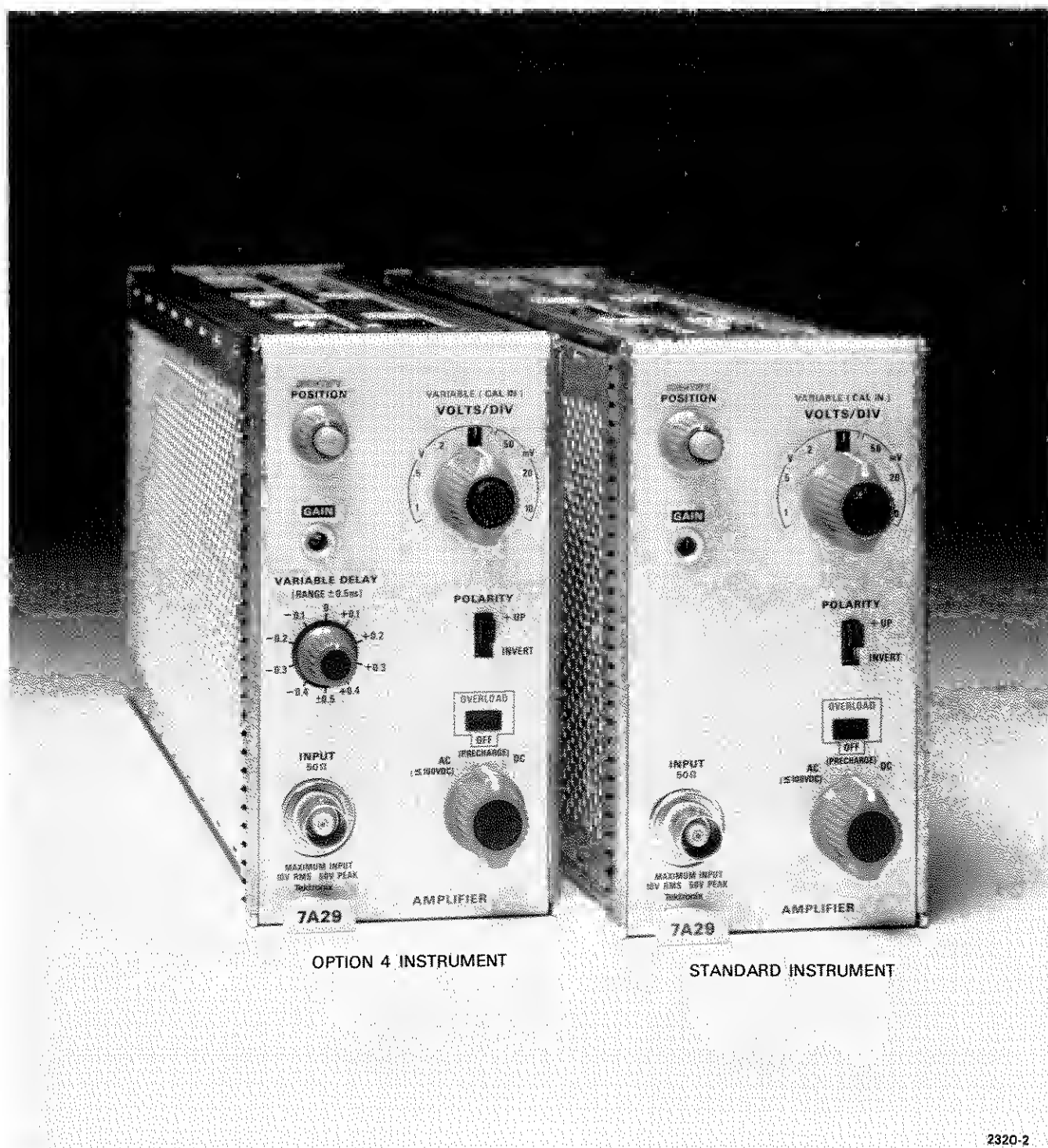
*The Main Amplifier circuit board is a multilayer type with two identical conductive paths laminated between the top and bottom board layers. All soldering on this board should be done with care to prevent breaking the connections to the center conductors. Only experienced maintenance personnel should attempt repair of any circuit board.*

#### USE PROPER CLEANING AGENTS

*Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a nonresidue type of cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or a fluorinated solvent (i.e. trifluorotrichloroethane), such as Freon TF cleaner or Spray-On #2002. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

#### DO NOT USE PIN SOCKETS FOR CONNECTION POINTS

*The spring tension of the pin sockets ensures a good connection between the circuit board and the pin. This spring tension can be destroyed by using the pin sockets as a connecting point for spring-loaded probe tips, alligator clips, etc.*



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### 7A29 FEATURES

The 7A29 is a wide-bandwidth Amplifier Plug-In Unit designed primarily for use in vertical compartments of the 7000-Series Oscilloscopes. The input is 50-ohm impedance with selectable DC or AC coupling and automatic overload disconnect. Seven calibrated deflection factors, VARIABLE deflection factor and polarity INVERT selections are provided. Readout encoding provides for deflection factor readout including coded probes, uncalibrated indication, polarity INVERT and IDENTIFY functions. A Variable Signal Delay of +0.5 ns is available with the Option 4 instrument.

# GENERAL INFO

## INTRODUCTION

The Instruction Manual is divided into the following main sections:

Section 1—General Information contains instrument description, electrical specifications, environmental characteristics, standard and recommended accessories, installation, and packaging for shipment instructions.

Section 2—Operating Instructions contains information relative to operating and checking the instrument operation.

WARNING

THE REMAINING PORTIONS OF THIS INSTRUCTION MANUAL CONTAIN SERVICING INSTRUCTIONS. THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK OR OTHER PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT DESCRIBED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

Section 3—Theory of Operation contains basic and general circuit analysis that may be useful for servicing or operating the instrument.

Section 4—Maintenance describes routine and corrective maintenance procedures with detailed instructions for replacing assemblies, subassemblies, and individual components.

Section 5—Calibration contains procedures to check the operational performance and electrical characteristics of the instrument. Procedures also include methods for adjustment of the instrument to meet specifications.

Section 6—Instrument Options contains a description of available options and locations of incorporated information for those options.

Section 7—Replaceable Electrical Parts contains information necessary to order replaceable parts and assemblies related to the electrical functions of the instrument.

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## General Information—7A29

front of the oscilloscope and the latch at the bottom left corner of the 7A29 will be in place against the front panel when the 7A29 is fully installed.

To remove the 7A29, pull on the release latch (inscribed with the unit identification "7A29") and the 7A29 will unlatch. Continue pulling to slide the 7A29 out of the oscilloscope.

## OPERATING TEMPERATURE

The 7A29 can be operated where the ambient air temperature is between 0° and +50° C and can be stored in ambient temperatures from -55° to +75° C. After storage at temperatures outside the operating limits, allow the chassis temperature to reach a safe operating temperature before applying power.

## PACKAGING FOR SHIPMENT

If this instrument is to be shipped for long distances by commercial transportation, we recommend that the instrument be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved for this purpose.

If this instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following: Owner of the instrument (with address), the name of the person at your firm who can be contacted, complete instrument type and serial number, and a description of the service required.

If the original packaging is unfit for use or not available, package the instrument as follows:

1. Obtain a corrugated cardboard carton with at least a 200-pound test strength and dimensions at least six inches larger than the instrument's dimensions.
2. Surround the instrument with polyethylene sheeting, or equivalent, to protect the instrument.
3. Allow a 3-inch cushion on all sides by tightly packing dunnage or urethane foam between the carton and the instrument.
4. Seal the carton with shipping tape or with an industrial stapler.
5. Mark the address of the Tektronix Service Center and your return address in one or more prominent locations on the exterior of the shipping carton.

# SPECIFICATIONS

The electrical characteristics listed in Table 1-1 apply when the following conditions are met: (1) Adjustment of the instrument must have taken place at an ambient temperature between +20° C and +30° C, (2) the instrument must be allowed a 30-minute warm-up period, and (3) all specifications are valid at an ambient temperature of 0° to +50° C, unless otherwise stated.

TABLE 1-1  
Electrical Characteristics

Characteristics	Performance Requirement
Deflection Factor	
Calibrated Range	From 10 mV/div to 1 V/div in 7 switch positions using a 1-2-5 switching sequence.
Attenuator Accuracy	All deflection factors within 2% with gain adjusted at 0.1 VOLTS/DIV when driven from a 50 $\Omega$ source.
VARIABLE (VOLTS/DIV) Range	At least 2.5:1. See Figure 1-1 for effect on bandwidth.
GAIN Range	Adjustable to at least 3% from nominal at 0.1 V/div.

**TABLE 1-1 (CONT.)**  
**Electrical Characteristics**

Characteristic	Performance Requirement
Frequency Response (10 mV/DIV to 1 V/DIV) High Frequency, AC or DC Coupled	When operated in the vertical compartment of the following oscilloscope series: 7100, 1 GHz (0° to 35° C); 7900, 500 MHz (0° to 30° C); 7800, 400 MHz (0° to 35° C); 7700, 175 MHz; 7600, 100 MHz; 7300, 25 MHz.  <b>NOTE</b>  <i>Use of the VARIABLE (Volts/Div) control effects frequency response. See Figure 1-1.</i>
Low Frequency, AC Coupled	1 kHz or less from a 50 $\Omega$ source; 200 Hz or less with a 10X 50 $\Omega$ probe.
Maximum Input DC Coupled	10 V rms or 1-watt-second pulses not exceeding 50 V peak. See Figure 1-2, and Detailed Operating Information, section 2.
AC Coupled	100 V additional dc component. Derate linearly to 0 V additional at 60 Hz.  <div style="text-align: center;"><b>CAUTION</b></div> <i>Signals of more than 50 V peak amplitude must be connected with input switch in OFF position so that input coupling capacitor is precharged.</i>
Input Protection Disconnect Threshold	+10 V dc within 2 V dc, -10 V dc within 2 V dc, or approximately 10 V rms up to 100 MHz.
Input Protection Disconnect Time	Less than 30 ms for 50 V dc of either polarity; 40 ms to 150 ms for 25 V dc of either polarity.
Input Impedance Resistance	Dc coupled: 50 $\Omega$ within 1 $\Omega$ . Ac coupled: 50 $\Omega$ within 1 $\Omega$ in series with at least 1.6 $\mu$ F.
Reflection Coefficient	0.05 or less in a 1 GHz $\pm$ 20% time domain reflectometer system.
VSWR (Except Option 4) DC Coupled	1.4:1 at 10 mVOLTS/DIV. 1.20:1 from 20 mVOLTS/DIV to 1 VOLTS/DIV; dc to 1 GHz.
AC Coupled	1.4:1 at 10 mVOLTS/DIV. 1.20:1 from 20 mVOLTS/DIV to 1 VOLTS/DIV; 1 MHz to 1 GHz.
VSWR (Option 4) DC Coupled	1.5:1 dc to 800 MHz.
AC Coupled	1.5:1, 1 MHz to 800 MHz.
Input Offset Current	50 $\mu$ A or less.
VARIABLE (VOLTS/DIV) Balance	0.2 div maximum trace shift.

**TABLE 1-1 (CONT.)**  
**Electrical Characteristics**

Characteristic	Performance Requirement
POLARITY Balance	0.5 div maximum trace shift.
IDENTIFY	Deflects trace upward 0.2 to 0.4 div.
POSITION Range	9 div each direction from graticule center within 1.0 div.
DC Drift	
Drift With Ambient Temperature (Line Voltage Constant)	0.04 div/°C or less.
Delay Range (Option 4 only)	At least 1 ns.

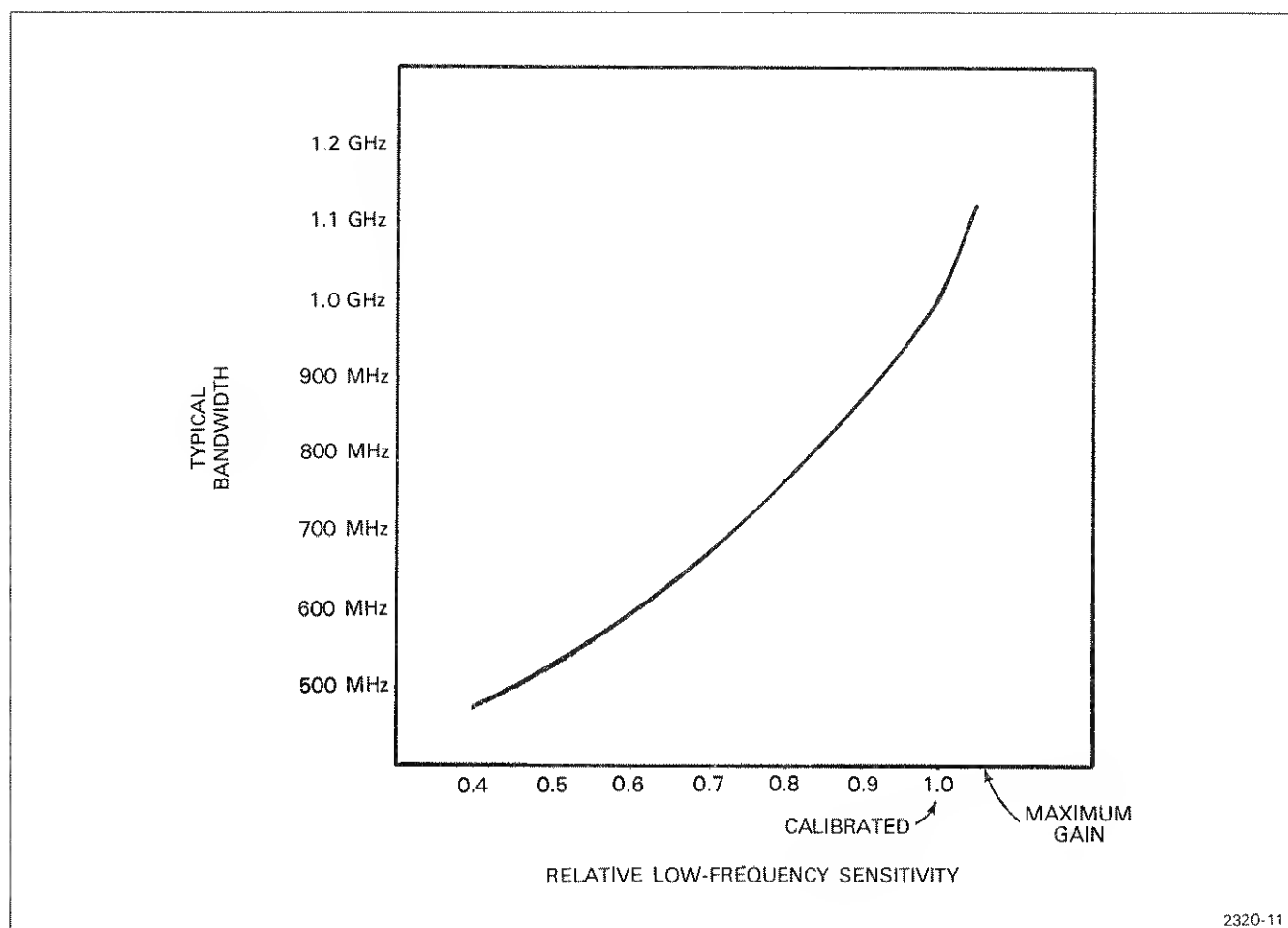


Figure 1-1. VARIABLE (Volts/Div) control effect on bandwidth.



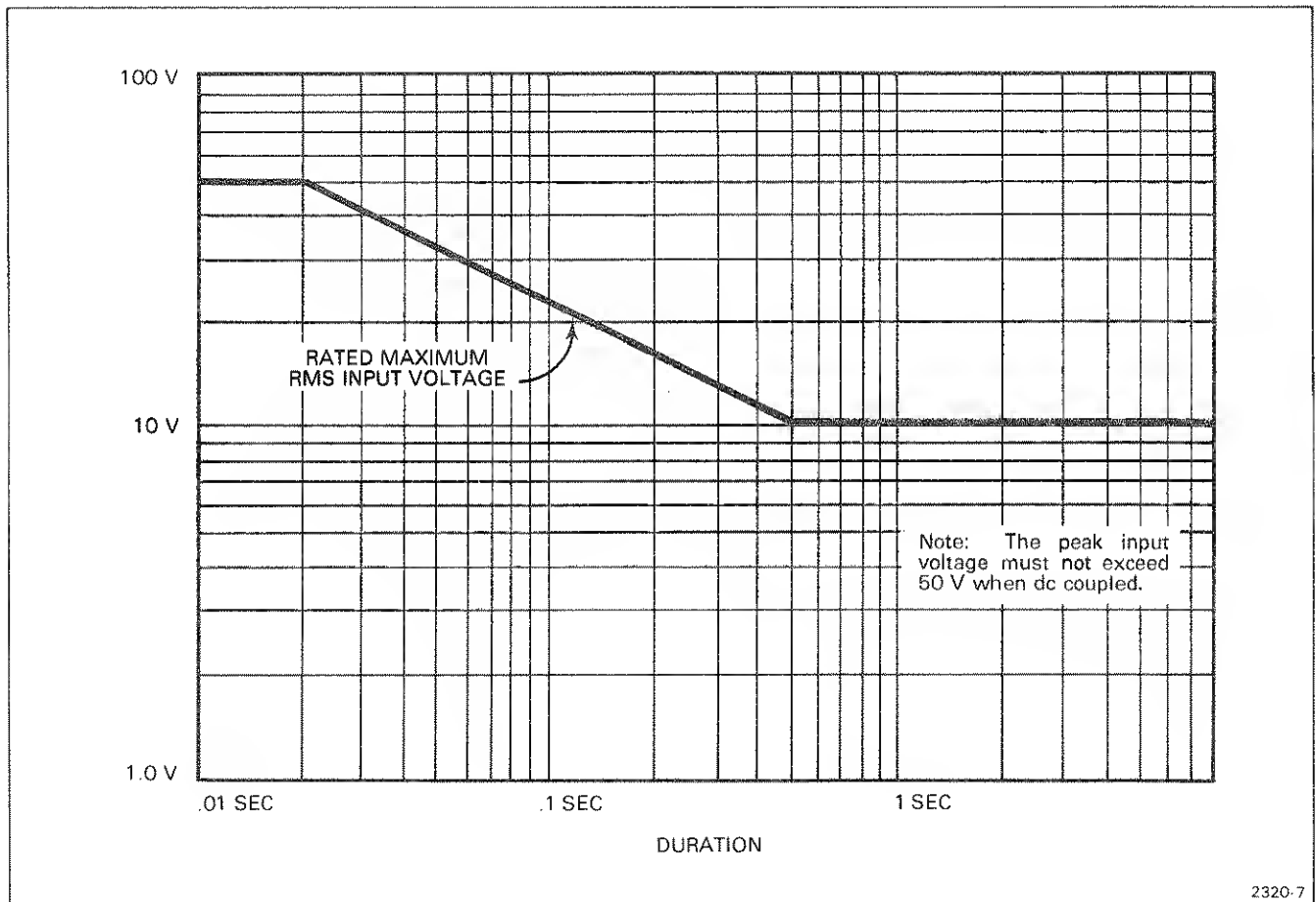


Figure 1-2. Maximum rms input voltage.

TABLE 1-2  
Environmental Characteristics

Characteristic	Performance Requirement
Temperature	
Calibration	+20° to +30°C (+68° to +86° F).
Operating	0° to 50° C (+32° to +122° F).
Storage	-55° to +75° C (-67° to +167° F).
Altitude	
Operating	To 15,000 feet.
Storage	To 50,000 feet.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

**TABLE 1-3**  
**Physical Characteristics**

Characteristic	Performance Requirement
Overall Dimensions	Compatible with all 7000-series plug-in compartments; see Figure 1-3, for dimensional drawing.
Net Weight	
Standard Instrument	Approximately 2 lbs. 8 oz. (1.14 kg).
Option 4 Instrument	Approximately 3 lbs. 4 oz. (1.48 kg).

## STANDARD ACCESSORIES

1 ea ..... Instruction Manual

### RECOMMENDED ACCESSORIES

The following accessories have been selected from our catalog specifically for your instrument. They are listed as a convenience to help you meet your measurement needs. For detailed information and prices, refer to a Tektronix Products Catalog or contact your local Tektronix Field Representative.

#### PROBES

##### P6056

The P6056 is a passive 10X attenuating probe with a bandwidth of dc to 3.5 gigahertz, and a 500 ohm input resistance for use with 50 ohm inputs.

##### P6057

The P6057 is a passive 100X attenuating probe with a bandwidth of dc to 1.4 gigahertz and a 5 kilohm input resistance for use with 50 ohm inputs.

##### P6201

The P6201 is an active (FET) nonattenuating probe with a bandwidth from dc to 900 megahertz, an input impedance of 100 kilohms and 3 picofarads (1 megohm and 1.5 picofarads with 10X and 100X attenuating heads).

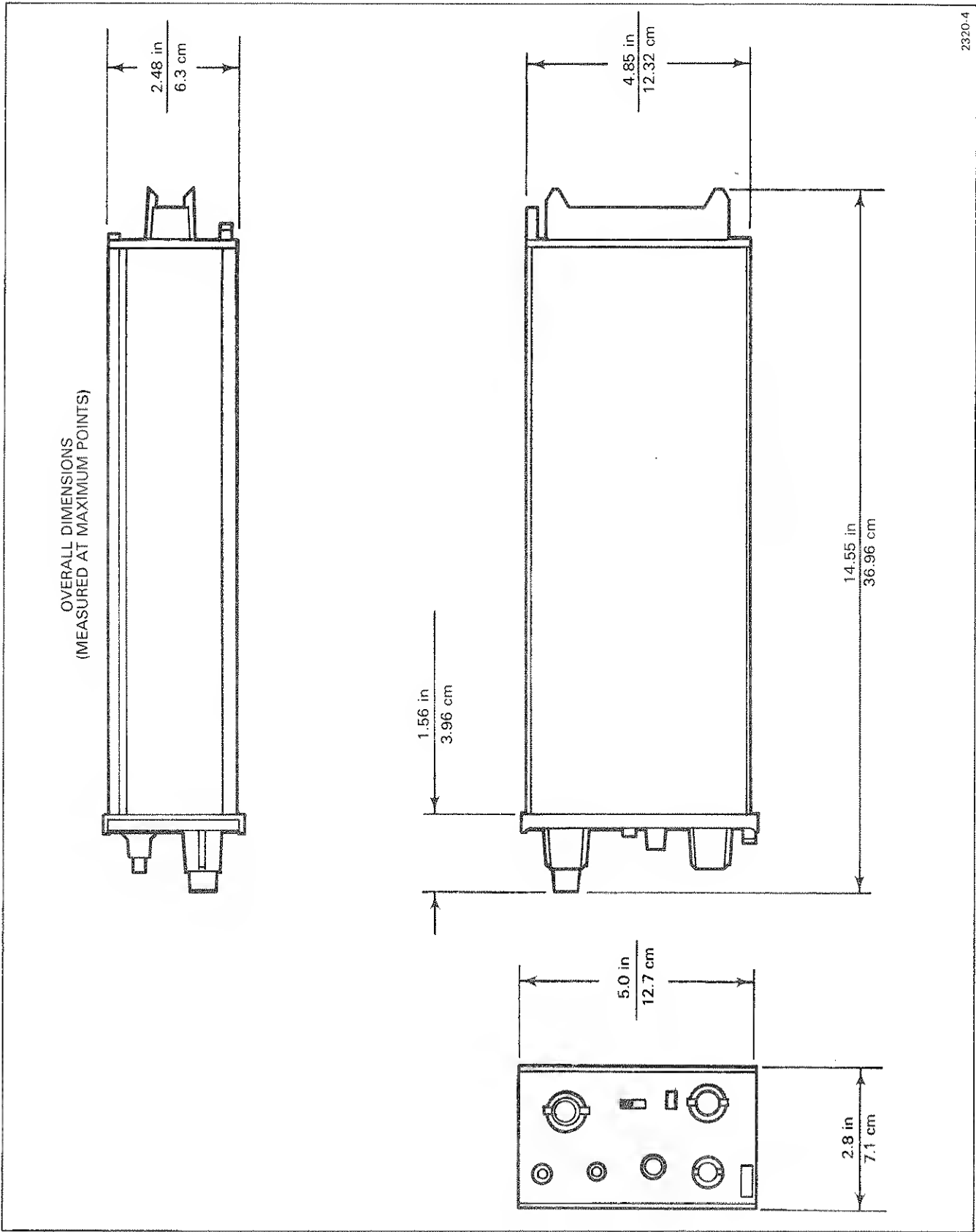


Figure 1-3. 7A29 dimensional drawing.



# OPERATING INSTRUCTIONS

To use the 7A29 effectively, the operation and capabilities of the instrument must be known. This section describes front-panel control functions, general information on signal input connections, and other subjects that pertain to various measurement applications.

## CONTROLS AND CONNECTORS

### CAUTION

*Before applying any signal in excess of 10 volts to the 7A29, refer to Detailed Operating Information given later in this section of the manual.*

The 7A29 front panel is shown in Figure 2-1. A brief, functional description of each control and connector is included in the illustration. Refer to Detailed Operating Information for additional information.

## CHECKOUT PROCEDURE

The following procedure can be used for incoming inspection to verify proper operation, and may also be used by the operator for instrument familiarization. Only instrument functions (not measurement quantities or specifications) are checked in the procedure; therefore, a minimum amount of test equipment is required. If performing the Checkout Procedure reveals improper performance or instrument malfunction, first check the operation of associated equipment; then refer to qualified service personnel for repair or adjustment of the instrument.

### NOTE

*Refer qualified service personnel to the Calibration section of this manual for the procedure to check the Option 4 VARIABLE DELAY control.*

## BEFORE YOU BEGIN:

Refer to the Change Information at the rear of this manual for any modifications which may affect this procedure.

## TEST EQUIPMENT REQUIRED

The following test equipment was used in preparing the Operators Checkout Procedure. Other test equipment which meets these requirements may be substituted. When other equipment is substituted, the control settings or setup may need to be altered.

1. 7000-series oscilloscope mainframe (e.g. 7104, 7904, or 7704A).

2. 7B-series time-base unit (e.g. 7B10, 7B15, 7B80, or 7B85).

3. One bnc cable: 50-ohm coaxial, Tektronix Part 012-0057-01.

## SETUP PROCEDURE

1. With the 7000-series oscilloscope power switch in the off position, connect the oscilloscope to a suitable power source.

2. Install the 7A29 in the left vertical compartment.

3. Install the 7B-series time-base unit in the B horizontal compartment.

4. Set the front-panel controls as follows:

### 7A29 AMPLIFIER:

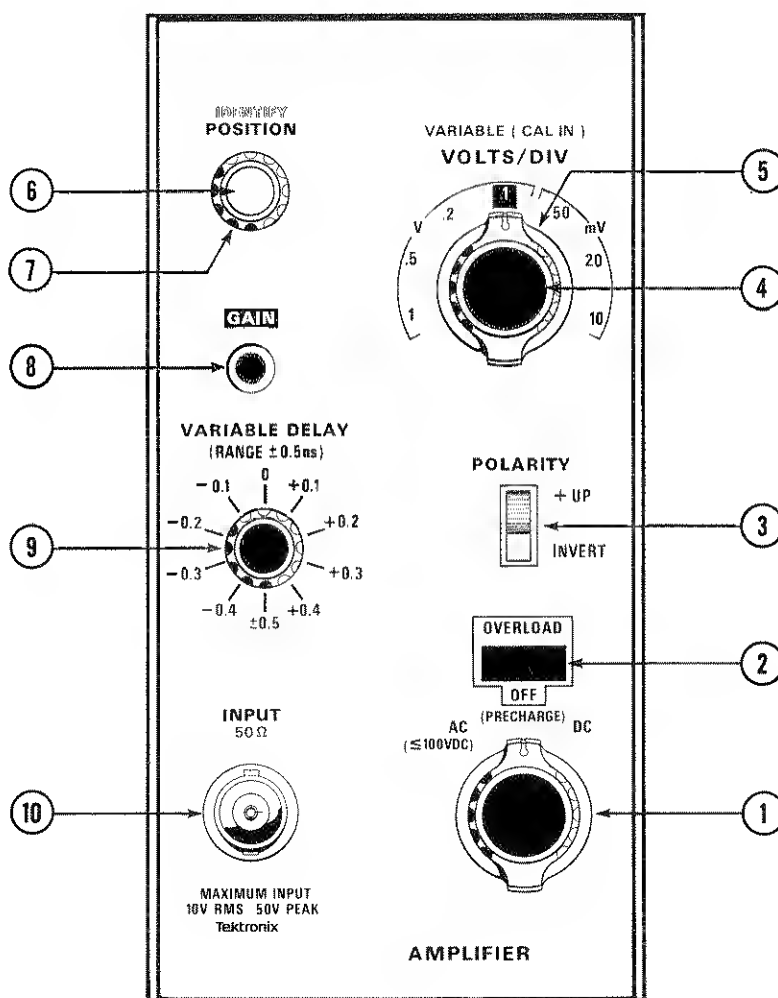
VOLTS/DIV .....	0.1 V
VARIABLE (Volts/Div) .....	CAL IN
POSITION .....	Midrange
POLARITY .....	+UP
AC-OFF-DC .....	OFF

### Time-Base Unit:

Time/Div .....	1 ms
Position .....	Midrange
Magnifier .....	X1
Triggering	
Mode .....	Auto
External Trigger In .....	In
Coupling .....	AC
Source .....	Internal

### Oscilloscope:

Vertical Mode .....	Left
Horizontal Mode .....	B
B Trigger Source .....	Vert Mode
Calibrator .....	4 V
A and B Intensity .....	Counterclockwise



- AC-OFF-DC (Switch)**—Selects signal input coupling mode.
- ① **AC:** The ac component of the signal is coupled to the amplifier input while the dc component is blocked.
- OFF:** Disconnects input signal, precharges input coupling capacitor, and resets input protection system when OVERLOAD light is on.
- DC:** Both ac and dc components of the signal are coupled to the amplifier input.
- ② **OVERLOAD (Indicator)**—When on, indicates that input signal exceeded the safe input level.
- ③ **POLARITY (Switch)**—Provides a means of inverting the display.
- +UP:** A positive-going signal at the INPUT connector deflects the crt display upward.
- INVERT:** A positive-going signal at the INPUT connector deflects the crt display downward.
- ④ **VARIABLE (Control)**—Provides continuously variable deflection factors between settings of the VOLTS/DIV switch.
- ⑤ **VOLTS/DIV (Switch)**—Selects calibrated deflection factors from 10 mV/Div to 1 V/Div; 7 steps in a 1-2-5 sequence.
- ⑥ **IDENTIFY (Switch)**—Deflects the trace about 0.2 division for trace identification. In instruments with readout, also replaces readout with the word "IDENTIFY".
- ⑦ **POSITION (Control)**—Controls the vertical position of the trace.
- ⑧ **GAIN (Control)**—Screwdriver adjustment permits calibration of deflection factor.
- ⑨ **Option 4 VARIABLE DELAY (Control)**—Delays the signal up to + and - 500 picoseconds by using a calibrated 10 turn dial (deleted on the standard 7A29).
- ⑩ **INPUT (Connector)**—Provides a means for connecting a signal.

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Figure 2-1. Front-panel controls, connectors and indicators.

5. Set the oscilloscope's power switch on and allow at least 20 minutes warmup.

## AMPLIFIER FUNCTIONS

1. Connect a bnc cable from the oscilloscope's calibrator output connector to the 7A29 INPUT connector.

2. Rotate the B intensity control clockwise until the trace is just visible.

3. Set the 7A29 AC-OFF-DC switch to DC.

4. With the POSITION control, align the display with the center 4 divisions of the graticule area. Adjust the GAIN (screwdriver adjustment) for 4 divisions of display.

5. With the POSITION control, align the bottom of the displayed signal with the center horizontal graticule line.

6. Set the AC-OFF-DC switch to AC. Notice that the displayed signal shifts downward approximately 2 divisions, and that the tops of the waveforms are tilted.

7. Set the AC-OFF-DC switch to DC. With the POSITION control, align the trace with the center and top-most graticule lines.

8. Set the POLARITY switch to the INVERT position. Notice that the displayed signal is now inverted, being roughly aligned with the center and bottom graticule lines.

9. Set the POLARITY switch to the +UP position.

10. Rotate the POSITION control fully counterclockwise and notice that the displayed signal can be positioned off the graticule area at the bottom of the crt.

11. Set the POLARITY switch to INVERT.

12. Rotate the POSITION control fully clockwise, and notice that the displayed signal can be positioned off the graticule area at the top of the crt.

13. Return the POLARITY switch to the +UP position. Position the display to the center 4 divisions of the graticule area.

14. Press to release the VARIABLE (Volts/Div) control. Rotate the VARIABLE (Volts/Div) control fully counterclockwise and notice approximately 1.6 divisions of displayed signal. Rotate the VARIABLE (Volts/Div) control fully clockwise and notice at least 4 divisions of displayed signal.

15. Press the VARIABLE (Volts/Div) control in.

16. Set the AC-OFF-DC switch to the OFF position and notice that no signal is displayed on the crt.

17. Press the IDENTIFY button. Notice that the displayed trace is deflected upward approximately 0.25 division and, in oscilloscope mainframes equipped with readout, notice that the 7A29 readout display is replaced with the word "IDENTIFY".

18. Rotate the VOLTS/DIV control through each position and note that the 7A29 readout display corresponds with the front-panel nomenclature. Change the POLARITY switch to INVERT. Rotate the VOLTS/DIV control through each position. Again note that the 7A29 readout display corresponds with the front-panel nomenclature. Note additionally that a downward-pointing arrow appears within the readout display.

19. Press and release the VARIABLE (Volts/Div) control. Note that a ">" symbol appears in the readout display between the downward pointing arrow and the deflection factor information.

20. Change the POLARITY switch to +UP. Note the disappearance of the "I" symbol. Press and latch the VARIABLE (Volts/Div) control. Note the disappearance of the ">" symbol.

21. Disconnect the bnc cable from the INPUT connector of the 7A29.

22. Connect a 10X readout-encoded probe to the INPUT connector and note the corresponding change in the deflection factor of the displayed readout. Repeat with 100X probe.

## NOTE

*Readout encoding is accomplished by connecting a resistance from the outer ring of the 7A29 INPUT connector to ground. The following gives the resistance value necessary to simulate a probe, and may be used in place of an actual probe.*

<u>Function</u>	<u>Resistance</u>
X1 .....	Open circuit
X10 .....	11 K $\Omega$ , within 5%
X100 .....	6.2 k $\Omega$ , within 5%
IDENTIFY .....	0 ohms

23. This completes the Operators Checkout Procedure.

## DETAILED OPERATING INFORMATION

### PROBES

Probes recommended for use with the 7A29 are the P6056 (10X) or P6057 (100X). Both probes are compatible with 50-ohm systems, and will allow good frequency response. These probes also contain trace IDENTIFY and readout encoding functions.

If the P6201 Probe is used, a one-megohm input impedance may be achieved (with some loss in bandwidth). Consult your local Tektronix Field Engineer or Representative for further information.

### VERTICAL GAIN CHECK AND ADJUSTMENT

To check the gain of the 7A29, set the VOLTS/DIV switch to 0.1 V and connect a 0.4 V, 1 kHz signal from the oscilloscope mainframe calibrator to the 7A29 INPUT connector.

#### NOTE

*Oscilloscope calibrators typically have an output impedance of either 50  $\Omega$  or 450  $\Omega$ . The 50-ohm input impedance of the 7A29 forms a voltage divider with the calibrator output impedance, reducing the voltage to the 7A29 by a precise factor of 2 (for 50-ohm calibrators) or 10 (for 450-ohm Calibrators). Thus the 4 V calibrator output of the 7104 and 7904 must be selected for an output voltage of 0.4 volts.*

The vertical deflection should be exactly four divisions. If not, adjust the front-panel GAIN adjustment for exactly four vertical divisions.

### INPUT COUPLING

The AC-OFF-DC switch allows a choice of input coupling methods. The type of display desired and the applied signal will determine the coupling to use.

The DC coupling position can be used for most applications. For signals with frequencies below about 1 kHz the DC coupling position is necessary to avoid signal attenuation.

In the AC coupling position the dc component of the signal is blocked by a 2 microfarad capacitor in the input circuit. The AC coupling position provides the best display of signals with a dc component much larger than the ac component.

In the OFF position of the input coupling switch, the signal path of the amplifier is interrupted so that there is no displayed signal. However, a signal connected to the INPUT connector will be loaded by approximately 390 kilohms dc, or by 195 kilohms ac. At extremely high frequencies a small portion of the input signal will still be displayed. For example, the signal attenuation in the OFF position is about 32 dB at 1 gigahertz.

The OVERLOAD protection feature of the 7A29 activates when a signal capable of causing damage (to 7A29 internal circuitry) is applied to the INPUT connector. To reset the 7A29, turn the AC-OFF-DC switch to the OFF position and remove the cause of overloading. The 7A29 is then ready for normal operation.

The 7A29 is capable of withstanding short term overloads in excess of its continuous rating of 10 V rms. Thus, it is possible to apply 50 V peak (the same as 50 V rms for a single pulse) for 20 ms, or a 20 V rms signal for 125 ms. The 7A29 integrates the rms input power and disconnects the signal before damage can occur.

Generally speaking, the 7A29 will protect itself from excessive (damaging) signals; however, there are exceptions. Continuous wave or pulsed radio frequency signals above 100 MHz are not sensed by the input protection circuitry and may cause damage to the input attenuator if in excess of the 10 V rms, 50 V peak, rating.

The relay contacts which disconnect the 7A29 from excessive voltages may themselves be damaged by arcing. If the contacts open with a signal greater than 50 V applied to the INPUT, the contacts may be permanently damaged.

The ac coupling capacitor used in the AC position of the AC-OFF-DC switch is rated at 100 V dc. Since the input protection circuitry is located after the ac coupling capacitor, application of up to 100 V dc to the INPUT is possible in the AC coupled mode. However, in order to avoid a fast-rise pulse being sent to the 7A29 from a signal in excess of 50 V dc, turn the AC-OFF-DC switch to OFF before connecting such a signal to the 7A29 INPUT. In the OFF position, the ac coupling capacitor is safely precharged to the average dc voltage.

Figure 1-2 in section 1 shows the maximum rms amplitude which may safely be applied to the 7A29 INPUT. Figure 1-2 also corresponds approximately to the rms voltage the 7A29 will accept without automatically disconnecting itself. A complex pulse, whose rms value is equal to the amount shown in Figure 1-2, is safe if it is also less than 50 V peak.

For example, a 30 V rms sinusoid may be applied for up to 55 ms, but a 36 V rms sinusoid may not be applied because the peak voltage exceeds 50 V. The 7A29 INPUT may be connected to a 50 V power supply for up to 20 ms because the rms and peak values of the resulting pulse are both 50 V.



## VOLTS/DIV SWITCH

The amount of deflection produced by a signal is determined by the signal amplitude, the attenuation factor of the probe, and the setting of the VOLTS/DIV switch. Calibrated deflection factors represented by the VOLTS/DIV switch apply only: (1) When the probe attenuation is X1 or when the input signal is appreciably above 1 kHz with AC coupling (the dc blocking capacitor attenuates signals below 1 kHz), and (2) when the VARIABLE (Volts/Div) control is in the CAL IN position.

## POLARITY SWITCH

The POLARITY switch provides a means of inverting the displayed signal. With the POLARITY switch set to +UP, a positive-going signal at the INPUT produces an upward deflection on the crt display. With the POLARITY switch set to INVERT, a positive-going signal will produce a downward deflection on the crt display.

## TRACE IDENTIFICATION AND READOUT FUNCTIONS

When the IDENTIFY button is pressed, the trace is deflected upward about 0.3 divisions to identify the 7A29 trace. This feature is particularly useful when multiple traces are displayed on the crt. In oscilloscope mainframes with readout, the IDENTIFY button also replaces the 7A29's deflection factor readout display with the word "IDENTIFY". The 7A29 is equipped with probe encoding circuitry that, when used with a coded probe, corrects the deflection factor readout.

## VARIABLE DELAY (OPTION 4)

The option VARIABLE DELAY line provides a means for delaying the signal applied to the INPUT connector up to  $\pm 500$  picoseconds relative to another 7A29, a 7A19, or 7A19 Option 4. When the Option 4 instrument is used with a standard 7A29 (which has a fixed delay) the

VARIABLE DELAY control can be used to match the signal delay time of both units.

## MATCHING DELAY TIMES USING TWO 7A29 UNITS, ONE HAVING VARIABLE DELAY (OPTION 4)

In some applications it is necessary to view the time relationship of two signals, one with respect to the other. With high speed signals, the delay times of the probes and amplifiers can distort the true time relationship of the two signals. By using the VARIABLE DELAY (Option 4), the delay times between the two units can be matched to within a few picoseconds, thus giving a true time relationship of the signals being viewed.

For matching delay times of two 7A29 units with probes, proceed as follows:

1. Install the standard 7A29 in the left vertical plug-in compartment of the oscilloscope.
2. Install the 7A29 Option 4 in the right vertical plug-in compartment.
3. Connect both 7A29 INPUT connectors to one of the signal sources and adjust the time-base unit for the fastest convenient sweep available.
4. Set the oscilloscope's trigger source switch to Left Vert, and vertical mode switch to Alternate.
5. Set both 7A29 units to the same deflection factor settings.
6. Center both displays vertically.
7. Adjust the front-panel VARIABLE DELAY knob so that the two displays are superimposed. The delay times of both units and the associated cables (or probes) are now matched.



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